



STUDIES OF SEASONAL VARIATIONS IN PHYTOPLANKTON DENSITY OF A SMALL HIMALAYAN HILL STREAM

BACHCHAN GAD

Dr. Ashok Kumar Badoni

Lecturer, SSRSR Govt. I. College Manjakot (Chauras) Tehri Garhwal, PIN- 249161 Uttarakhand, India.

ABSTRACT

In the present study phytoplankton density and physico-chemical parameters were studied in Bachchan Gad. A total of 30 genera of phytoplankton belonging to the families Chlorophyceae (8 genera), Bacillariophyceae (19 genera) and Cyanophyceae (3 genera) were recorded during the present investigation. Regular sampling for the physico-chemical parameters were confined to temperature (air and water), mean velocity, mean depth, mean width, dissolved oxygen and pH. Overall variation recorded in phytoplankton density, due to change in physico-chemical nature, variation in altitude and longitude channel course, substratum and geometry of the stream.

KEY WORDS: Seasonal variation, Phytoplankton density, Bachchan Gad.

1. INTRODUCTION:

Diatoms are unicellular algae usually microscopic that are characterized by having a cell wall of silica. Diatoms are important link in the food cycles. It is estimated that out of the total primary production 20 % is produced by the diatoms alone. Diatoms are widely distributed throughout the fresh and salty waters of the world. They are also found in damp mud and on moist plants such as Sphagnum (Patrick, 1948) although some are very tolerant of widely varying ecological conditions. The diatoms exhibit remarkable differences in its compositions and percentage occurrence in polluted water as compared to non-polluted water. The phytoplankton of hill stream has been extensively studied in most parts of the world. Notable among these are by Krieger (1927), Butcher (1932) and Crayton and Sommerfield (1977). In the Indian uplands phytoplanktons have been studied by Raina et.al. (1984), Bhatt et.al. (1985), Sharma (1985), Nautiyal (1985), Sharma et.al. (1992), Badoni (1997), Dobriyal and Joshi (1999), Bahuguna and Badoni (2002) and Sharma et.al.(2007).

Physiography of Study area:- The stream basin lies in the Rudraprayag district in Garhwal Himalaya between latitude 30° 10' and 20° 15' N and longitude 78° 55' and 79° 0 E'. The confluence of Bachchan Gad and Alaknanda is downstream to Khankara (610 mtr a.s.l.) enroute to Badrinath. Geologically the area falls in lesser Himalaya. Three sampling site were selected from upper, middle and lower part of the stream for the present study. The sampling site S1 situated at Fathepur (625mtr a.s.l.) towards the head waters region of the stream. Substratum of this site constituted mainly of cobbles and boulders. The valley slopes along this site were canopied. The site S2 was situated at Khankara (610 mtr a.s.l.) 3km(approx) downstream to S1. Substratum of this site also constituted mainly of cobbles and pebbles along with sand grains in between the valley wider downstream. Sampling site S3 (590 mtr a.s.l.) at confluence of Bachchan Gad

with river Alaknanda. The stream channel predominantly consists of boulders, cobbles and pebbles with sand grains.

2. MATERIALS AND METHODS:

Standard methods outlined in Welch (1949), Golterman et.al. (1969) and APHA (1981) were followed for the sampling and analysis of the physico-chemical parameters of the stream. During the present investigation regular sampling was done to collect the diatoms from the stream by using silk and bolt method (1975). 100 liter of water from rapid and pool at each sampling site was filtered through 21 bolting silk plankton net. Diatoms were collected in glass bottles and fixed in 5% formalin. The quantitative and qualitative analysis of diatoms was made under microscope in Sedwick-Rafter counting cell and calculated according to Welch (1949). Identification of diatoms was made from; Ward and Whipple (1959), Needham and Needham (1962), Sarode and Kamat (1980), and APHA (1981).

3. RESULTS:

3.1 Analysis of Physico-chemical parameters:

The various Physico-chemical factors observed in Bachchan Gad are depicted in **table-1**. The air temperature in the stream was observed to the minimum of 11.7 °C in February and maximum of 33.7 °C in June. Water temperature varied between minimum 10.8 °C in February and maximum 26.2 °C in June. The mean depth was observed minimum 0.20 meter in November and maximum 1.45 meter in July. The mean velocity was observed minimum 0.35 meter/sec in February and maximum in monsoon season 2.8 meter/sec in August. The dissolved oxygen was recorded minimum 10.7 mg/liter in August and maximum 14.0 mg/liter in December. The pH varied between 7.7 in March and maximum 8.4 in December.

Table- 1 Physico-Chemical Parameters (Mean values) of stream Bachchan Gad during the period 2013-2014.

Parameters	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Air Temp.(°C)	18.6	24	32.5	33.7	29.6	25.4	22.7	21.5	20	17.5	12.4	11.7
Water Temp.(°C)	15.4	20.7	23.7	26.2	23.4	21.7	19.4	17.2	18.2	14.4	11.0	10.8
Mean depth(mtr)	0.33	0.35	0.48	0.64	1.45	1.3	0.65	0.22	0.20	0.24	0.26	0.30
Mean velocity (m/s)	0.40	0.45	0.55	1.45	2.7	2.8	1.2	0.96	0.85	0.64	0.42	0.35
D.O(mg/l)	13.0	12.6	11.3	10.9	11.4	10.7	12.9	11.5	12.4	14.0	14.7	13.8
pH	7.7	8.1	8.2	7.9	8.3	8.0	7.9	7.8	8.0	8.4	8.2	8.0

3.2 Qualitative and quantitative analysis of Phytoplanktons:

During the present investigation a total of 30 genera of phytoplankton belonging to the families Chlorophyceae(8 genera), Bacillariophyceae (19 genera) and Cyanophyceae (3 genera) were recorded during the present investigation (**Table-2**). The maximum density of Bacillariophyceae (Diatoms) recorded in winter season (990.62±210.85 U/L) and minimum in monsoon season (429.21±92.70U/L).During the present study *Achnanthes*, *Coconeis*, *Fragilaria*, *Synedra*, *Frustulia* *Neidium*, *Pinnularia*, *Navicula*, *Gomphonema*, *Nitzschia*, *Cymbella*, *Diatoma*, *Diatomella* and *Tabellaria* were present throughout the year while the genera *Stauroneis*, *Surirella*, *Amphora*, *Meridion* and *Bacillaria*

were present in winter and summer but absent in monsoon season. The maximum density of Chlorophyceae (Green algae) recorded in summer season (272.99±82.53U/L) and minimum density recorded in monsoon season (84.64±26.20 U/L). *Spirogyra*, *Oedogonium*, *Ulothrix*, *Cladophora* and *Hydrodictyon* were present throughout the year while *Tetraspora*, and *Zygnema* recorded only in winter season and *Volvox* was present in winter and summer season while absent in monsoon season. The density of Cynophyceae recorded maximum in summer season (85.99±27.61 U/L) and minimum (23.33±15.31U/L) in monsoon season. *Anabena* and *Nostoc* were present only in summer season while *Oscillatoria* was present throughout the year.

Table-2 Seasonal variation in the occurrence of phytoplankton density (units/litre) of stream Bachchan Gad during the period 2013-2014.

Taxon	Winter	Summer	Monsoon
Chlorophyceae			
<i>Spirogyra Sp.</i>	59.33±4.71	63±13.36	19.33±10.37
<i>Tetraspora Sp.</i>	11.33±0.94	-	-
<i>Oedogonium Sp.</i>	30.33±13.71	38±13.36	14.66±3.77
<i>Ulothrix Sp.</i>	38.33±4.78	52.33±13.71	23.33±15.31
<i>Zygnema Sp.</i>	26.67±5.18	-	-
<i>Volvox Sp.</i>	30.33±18.69	41±18.23	-
<i>Cladophora Sp.</i>	22.66±8.57	30±4.96	11.66±1.24
<i>Hydrodictyon Sp.</i>	26.66±5.18	48.66±22.6	15.66±5.18
Total density	245.64±72.81	272.99±82.53	84.64±26.20
Bacillariophyceae			
<i>Achnanthes Sp.</i>	66.33±8.99	48±4.96	22.33±8.57
<i>Coconeis Sp.</i>	37±4.96	33.66±	19.33±10.37
<i>Fragilaria Sp.</i>	59.33±28.40	41.33±10.37	22.66±8.51
<i>Synedra Sp.</i>	62.33±5.18	48±18.23	23.33±17.17
<i>Frustulia Sp.</i>	58.66±5.18	23±7.78	27±12.56
<i>Stauroneis Sp.</i>	34±14.89	16±4.96	-
<i>Neidium Sp.</i>	34±16.75	26.66±	15±7.25
<i>Pinnularia Sp.</i>	51.33±13.7	40.33±10.37	22.33±8.57
<i>Navicula Sp.</i>	92.33±40.17	80.66±10.37	44.66±17.55
<i>Surirella Sp.</i>	26±5.65	13.66±1.69	-
<i>Gomphonema Sp.</i>	37.33±10.14	30.33±10.37	29.6±5.43
<i>Nitzschia Sp.</i>	62.66±28.40	40.66±10.14	25.33±17.63
<i>Cymbella Sp.</i>	85±13.92	77±8.98	62.66±22.17
<i>Amphora Sp.</i>	48±13.36	47.66±13.71	-
<i>Diatoma Sp.</i>	84.33±13.27	77±8.98	58.66±20.74
<i>Diatomella Sp.</i>	66±8.98	47.66±5.18	33.66±8.99
<i>Meridion Sp.</i>	29.66±13.27	22.66±8.57	-
<i>Tabellaria Sp.</i>	37.33±13.27	29.66±13.27	22.66±8.57
<i>Bacillaria Sp.</i>	19±4.96	15.66±5.18	-
Total density	990.62±210.85	759.59±162.13	429.21±92.70
Cyanophyceae			
<i>Anabena Sp.</i>	-	14.33±6.34	-
<i>Nostoc Sp.</i>	-	19.33±10.37	-
<i>Oscillatoria Sp.</i>	38±13.36	52.33±10.37	23.33±15.31
Total density	38±13.36	85.99±27.61	23.33±15.31

4. DISCUSSION:

There are many factors that controls the presence of phytoplanktons. Hora (1922) considered water current to be an important factor governing the nature of the biota in the streams. According to Hynes (1970) water movement, turbidity, temperature and nutrients are main factors. During the present observation the maximum density of Bacillariophyceae (Diatoms) recorded in winter season (990.62±210.85 U/L) and minimum in monsoon season (429.21±92.70U/L). The maximum density of Chlorophyceae (Green algae) recorded in summer season (272.99±82.53U/L) and minimum density recorded in monsoon season (84.64±26.20 U/L). The density of Cynophyceae recorded maximum in summer season (85.99±27.61 U/L) and minimum (23.33±15.31U/L) in monsoon season. Similar observations made by Chakraborty et.al. (1959), Pahwa and Mehrotra (1966) in river Jamuna and Ganga. Dobriyal and Singh (1988) in river Mandakini. Bahuguna and Badoni (2002) in three tributaries of river Alaknanda due to eco-physico-chemical nature (water depth, current and substratum), Sharma et.al. (2007) in hill stream Chandrabhaga Gad of Garhwal Himalaya due to seasonal fluctuations in physico-chemical parameters, Malik and Bharti (2012) in Sahastradhara stream of Uttarakhand due to low temperature, high amount of D.O., and low velocity. Overall variation recorded in phytoplankton density in stream Bachchan Gad due to change in physico-chemical nature, variation in altitude and longitude channel course, substratum and geometry of the stream.

ACKNOWLEDGEMENTS

Author is thankful to Prof. S. N. Bahuguna and Prof. O. P. Gusain Department of Zoology HNBGU (Central University) Srinagar Garhwal for help and guidance during the study.

REFERENCES:

1. APHA, AWWA and WPCF. (1981). Standard methods for the examination of water (15th ed.). American Public health Association, Washington D.C.
2. Badoni, Ashok Kumar (1997). Planktonic Diatoms of a Small hill stream Bachchan Gad. M.Sc. dissertation submitted to HNBGU Srinagar Garhwal. PP. 1-21.
3. Bahuguna S.N. and Badoni A.K. (2002). Qualitative and quantitative productivity of fish food from three important tributaries of river Alaknanda. Him. J. Env. Zoo., Vol. 16(2): pp. 215-222.
4. Bhatt, S.D., Y. Bisht and Negi. U. (1985). Hydrobiology and phytoplankton populations in river Kosi of the western Himalaya (U.P.). Ind. J. Ecol. 12, 1: 141-146.
5. Butcher, R.W. (1932). Studies in the Ecology of rivers II. The micro flora of rivers with special references to the algae on the river bed. Ann. Botany 46: 813-861.
6. Chakraborty, R.D., Roy, P., Singh, S.B. (1959). A quantitative study of plankton and the physico-chemical conditions of the river Yamuna at Allahabad in 1954-55. Indian J. Fish. 61: 186-208.
7. Crayton, W.M. and Sommerfield, M.R. (1977). Composition and abundance of phytoplankton in tributaries of the lower Colorado river, Canyon region, Hydrobiologia 661: 81-93.
8. Dobriyal, A.K. and Joshi, Hemant. (1999). Faunal diversity and its determinant factors in some Hill streams of Garhwal Himalaya. U.P. J. Zool. 19 (1): 85-87.
9. Dobriyal, A.K., and Singh, H.R. (1988). Ecological basis for ichthofaunal variations in two hill streams of Garhwal Himalaya. Ibid 1988; 3: 30-4.
10. Golterman, H.L., Clymo, R.S., and Ohnstad, M.A.M. (1969). Methods for physical and chemical analysis of freshwaters. Blackwell Sci. Publ. Oxford.
11. Hora, S.L. (1922). Structural modifications in fish of mountain torrents. Rec. Indian mus. 24: 31-61.
12. Hynes, H.B.N. (1970). The Ecology of Running Waters Liverpool Univ. Press.
13. Krieger, W. (1927). Zur biologie, des flussplankton pflanzen forschung 10: pp. 66.
14. Malik, D.S. and Bharti, Umesh. (2012). Status of plankton diversity and biological productivity of Sahastradhara stream at Uttarakhand, India. Journal of Applied and Natural Science 4(1) 96-103.
15. Nautiyal, P. (1985). Studies on the riverine ecology of torrential waters in the Indian uplands of the Garhwal region. I seasonal variations in percentage occurrence of planktonic algae. U.P. J. Zool. 51: 14-19.
16. Needham, J.G. and Needham P.R. (1962). A Guide to the study of freshwater biology (5th edition) Holden Day Inc. San Francisco.
17. Pahwa, D.V. and Mehrotra, S.N. (1966). Observations in the abundance of plankton in relation to certain hydro-biological conditions of river Ganges. Proc Natl Acad Sci., 36(2). 157-89.
18. Patrick, R. (1948). Factors affecting the distribution of diatoms. Bot. Rev. 14: 473-524.
19. Raina, V., Shah, A.R. and Ahmed, S.R. (1984). Pollution studies on River Jhelum I, an assessment of water quality. Ind. J. Env. Health, Vol. 26 No. 3. 187-201.
20. Sarode, P.T. and Kamat, N.D. (1980). Freshwater diatoms of Maharashtra. Saikripa Pra. Aurang. 1-338.
21. Sharma, A., Sharma, R.C. and Anthwal, A. (2007). Monitoring phytoplankton diversity in the hill stream Chandrabhaga of Garhwal Himalaya. Life Science Journal. 4: 80-84.
22. Sharma, R.C. (1985). Seasonal abundance of phytoplankton in the Bhagirathi river, Garhwal Himalayas, Ind. J. Ecol. 12, 1: 157-160.
23. Sharma, R.C., Gusain, O.P. and Juyal, C.P. (1992). Ecology of high altitude river Bhilangana of Garhwal Himalayas. In : R.K. Trivedi (ed.). River Pollution in India. Ashish Pub. House, New Delhi.
24. Ward H.B and Whipple G.C. (1959). Freshwater Biology W.T. Edmondson, 2nd Ed. John Wiley and Sons. Inc. New York.
25. Welch, P.S. (1949). Limnological methods. Mc Graw-Hill, Book Com. Inc. London.